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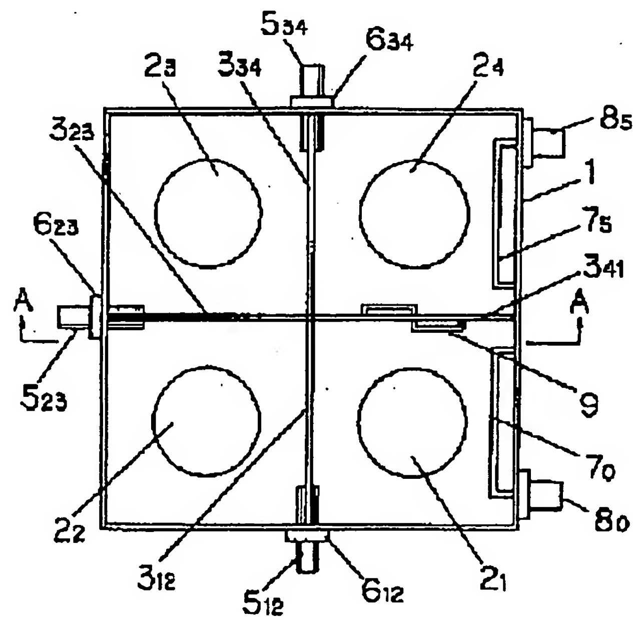
(54) BAND PASS FILTER COMPOSED OF DIELECTRIC RESONATOR

(57) Abstract:

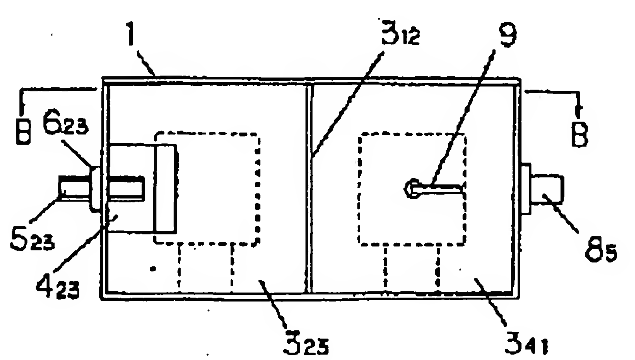
PURPOSE: To provide a band pass filter capable of standardizing parts and facilitating manufacture adjustment.

CONSTITUTION: Plural TE01δ mode dielectric resonator elements 21-24 are provided inside a common external conductor 1 so as to be cascade connected and partitions 312, 323, 334, and 341 composed of conductor plates are provided between the adjacent TE01δ mode dielectric resonator elements. The wall surfaces of the partitions 312, 323, 334 and 341 are vertical to a direction for connecting the adjacent TE01δ mode dielectric resonator elements and an inter-stage coupling hole 423 is pierced in a range reaching from an edge part in contact with the side wall of the common external conductor to a center direction. An inter-stage coupling coefficient adjustment element 523 attached to the side wall of the common external conductor corresponding to the pierced part of the inter-stage coupling hole 423 and composed of a metallic screw capable of changing the length of a part to be inserted to the inter-stage coupling hole 423 is provided. The axial center of the inter-stage coupling coefficient adjustment element 523 is approximately parallel to a coupling electric field in the inter-stage coupling hole 423 and approximately vertical to a coupling magnetic field.

(a)



(b)



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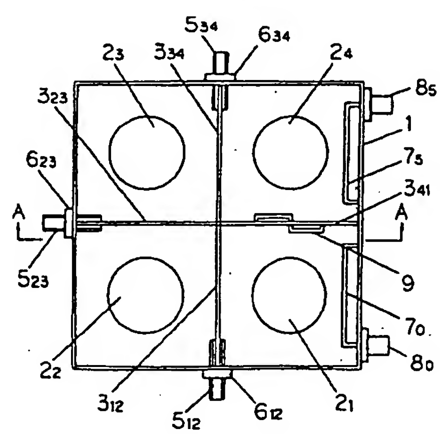
(54)【発明の名称】　誘電体共振器より成る帯域通過ろ波器

(57)【要約】

【目的】部品の標準化が可能で、製作調整の容易な帯域通過ろ波器を実現する。

【構成】共通の外部導体の内部に複数個のTE01δモード誘電体共振素子を縦続接続されるように設けてある。隣り合うTE01δモード誘電体共振素子の間に導体板より成る隔壁を設けてある。この隔壁の壁面は、隣り合うTE01δモード誘電体共振素子を連ねる方向と直角である。隔壁の周縁のうち、共通の外部導体の側壁に接する縁部から中心方向に到る範囲に段間結合孔を穿ってある。段間結合孔の穿設箇所に対応する共通の外部導体の側壁に取り付けられ、段間結合孔内に挿入される部分の長さを変えることのできる金属螺子より成る段間結合係数調整素子を設けてある。段間結合係数調整素子の軸芯は、段間結合孔における結合電界にほぼ平行で、結合磁界にほぼ直角である。

(a)



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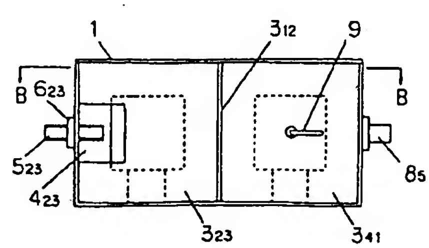


1

【特許請求の範囲】

【請求項1】共通の外部導体内において縦続接続される複数個のTE01δモード誘電体共振素子と、

前記複数個のTE01δモード誘電体共振素子のうち、隣り合うTE01δモード誘電体共振素子相互の間において、隣り合うTE01δモード誘電体共振素子を連ねる方向に直角に設けられ、導体板より成る隔壁と、

前記隔壁の周縁のうち、前記共通の外部導体の側壁に接する縁部から中心方向に到る箇所に穿たれた段間結合孔と、

軸芯が、前記段間結合孔の穿設箇所における結合電界にほぼ平行で、結合磁界にほぼ直角となると共に、内端が、前記段間結合孔内において前進後退させられるように設けられた段間結合係数調整素子とを備えたことを特徴とする誘電体共振器より成る帯域通過ろ波器。

【請求項2】段間結合係数調整素子が、共通の外部導体の側壁に螺合された金属螺子より成る請求項1に記載の誘電体共振器より成る帯域通過ろ波器。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、無線通信装置又は放送装置等において、高周波信号に含まれる雑音の除去等に用いられる帯域通過ろ波器として好適な帯域通過ろ波器或は高周波信号の合波又は分波に用いられる分波器の構成素子として好適な帯域通過ろ波器に関するものである。

【0002】

【従来の技術】図12（a）は、TE01δモード誘電体共振素子を備えた共振器を縦続接続して成る負荷Qの高い従来の帯域通過ろ波器の要部を示す断面図［図12（b）のB－B断面図］、図12（b）は、図12（a）のA－A断面図で、1は共通の外部導体、2_1及び2_2はTE01δモード誘電体共振素子、3_1ないし3_3は導体板より成る隔壁、24_2は隔壁3_2の中心部に穿った輪郭形状が円形の段間結合孔で、他の隔壁にも同様の段間結合孔を穿ってある。図13（a）もまたTE01δモード誘電体共振素子を備えた共振器を縦続接続して成る負荷Qの高い従来の帯域通過ろ波器の要部を示す端面図［図13（b）のB－B端面図］、図13（b）は、図13（a）のA－A断面図で、34_1ないし34_3は輪郭形状が角形の段間結合孔で、他の符号は図12と同様である。

【0003】

【発明が解決しようとする課題】図12又は図13に示した従来の帯域通過ろ波器においては、隔壁3_1ないし3_3の中心部に穿設した円形の段間結合孔24_2又は角形の段間結合孔34_1ないし34_3の大きさを変えることによって、段間結合係数を変化させて帯域通過ろ波器としての電気的特性を所要の特性に一致させているが、隔壁3_1ないし3_3に設けた段間結合孔24_2又は34_1ないし34_3の大きさを、所要の電気的特性に対応する大きさに一致させ

2

るためには、例えば、各種の大きさの結合孔を穿った隔壁を多数用意し、これらの隔壁の中から適当と思われる隔壁を繰り返し選択装着して、所要の大きさの段間結合孔を穿った隔壁を選び出しているので、段間結合孔の大きさを所要値に一致させるまでに、多くの時間と労力を必要とし、コスト高となるのを免れることができない。

【0004】

【課題を解決するための手段】本発明は、共通の外部導体内において縦続接続される複数個のTE01δモード誘電体共振素子と、前記複数個のTE01δモード誘電体共振素子のうち、隣り合うTE01δモード誘電体共振素子相互の間において、隣り合うTE01δモード誘電体共振素子を連ねる方向に直角に設けられ、導体板より成る隔壁と、前記隔壁の周縁のうち、前記共通の外部導体の側壁に接する縁部から中心方向に到る箇所に穿たれた段間結合孔と、軸芯が、前記段間結合孔の穿設箇所における結合電界にほぼ平行で、結合磁界にほぼ直角となると共に、内端が、前記段間結合孔内において前進後退させられるように設けられた段間結合係数調整素子とを備えた帯域通過ろ波器を実現することによって、従来の誘電体共振器より成る帯域通過ろ波器の欠点を除こうとするものである。

【0005】

【作用】段間結合係数調整素子の、共通の外部導体内への挿入長を変えることによって、段間結合係数が大幅に変化する。

【0006】

【実施例】図1（a）は、本発明の一実施例を示す断面図［図1（b）のB－B断面図、図1（b）は、図1（a）のA－A断面図で、1は共通の外部導体、2_1ないし2_4はTE01δモード誘電体共振素子で、比較的直径の大きい円柱状の固体誘電体より成る共振素子本体と、比較的直径の小さい円柱状の固体誘電体より成る支持部分とを同一材質の固体誘電体によって一体に形成するか、共振素子本体を比較的誘電率の高い固体誘電体で、支持部分を比較的誘電率の低い固体誘電体で、それぞれ別個に形成し、両者を接着剤で一体に接着して形成した共振素子より成る。図には、共振素子2_1ないし2_4の各本体の横断面の輪郭形状が円形の場合を例示してあるが、横断面の輪郭形状を角形に形成した共振素子を用いても本発明を実施することができる。3_{12}、3_{23}、3_{34}及び3_{41}はそれぞれ導体板より成る隔壁、4_{23}は段間結合孔で、隔壁3_{23}の周縁のうち、共通の外部導体の側壁に接する縁部から中心方向に到る箇所に設けてある。図には現われてはいないが、隔壁3_{12}及び3_{34}にも段間結合孔4_{23}と同様の段間結合孔を設けてある。5_{12}、5_{23}及び5_{34}はそれぞれ段間結合係数調整素子で、各調整素子と段間結合孔、結合電界及び結合磁界との関係を調整素子5_{23}を例にして説明する。調整素子5_{23}は、その軸芯が隔壁3_{23}の面に一致し、共通の外部導体1の側壁から段間結

合孔4_{23} 内への挿入長（以下、管内挿入長と記載する）を変えることができ、所要の管内挿入長において固定可能な金属素子、例えば共通の外部導体１の側壁に螺合させた金属螺子より成る。図には、調整素子5_{23} を段間結合孔4_{23} の高さ方向のほぼ中心部に取り付けた場合を例示してあるが、段間結合孔4_{23} 内において上下にずれた箇所に取り付けてもよい。又、図には、調整素子5_{23} の軸芯が、共通の外部導体１の側壁と直交するように設けた場合を例示してあるが、調整素子5_{23} の軸芯が、隔壁3_{23} に穿った段間結合孔4_{23} の面内において、斜め上向き又は斜め下向きとなるように、即ち、共通の外部導体１の側壁と斜交するように設けてもよく、要は、調整素子5_{23} の軸芯が段間結合孔4_{23} の穿設箇所における結合電界にほぼ平行で、結合磁界にほぼ直角となるように調整素子5_{23} を取り付けることによって本発明を実施することができる。他の調整素子5_{12} 及び5_{34} についても、調整素子5_{23} と同様である。7_0は入力（又は出力）結合素子、7_5は出力（又は入力）結合素子で、図には結合素子7_0及び7_5をループで形成した場合を例示してあるが、プローブ等の容量結合素子で形成してもよい。8_0は入力（又は出力）端子、8_5は出力（又は入力）端子で、それぞれ同軸接栓で形成した場合を例示してある。９は副結合素子で、図示のように、素子９をループで形成して共振素子2_1を含む共振器と共振素子2_4を含む共振器との間を副結合する代わりに、共振素子との間に容量を形成する電極を介して副結合回路を主回路に結合する従来公知の回路構成を採用してもよい。図１には、共振素子2_1ないし2_4より成る各共振器の共振周波数微調整素子を図示するのを省いてあるが、実際には、従来のTE01δモード誘電体共振器において用いられている微調整素子と同様の微調整素子、例えば固体誘電体より成る棒状体を、その長手方向が共振素子2_1ないし2_4の各軸方向、即ち、図１（ａ）において紙面に垂直な方向と平行となるようにして共通の外部導体１の上壁から共振器内へ挿入し、各管内挿入長を微細に変え得ると共に、所要の管内挿入長において固定し得るように形成した微調整素子を設けてある。

【０００７】図１には、共通の外部導体１の内部に隔壁3_{12} 、3_{23} 、3_{34} 及び3_{41} を十文字型に配設して共通の外部導体１の内部を４室に仕切り、各室に取り付けた共振素子2_1ないし2_4をコの字型に配設することによって全体を小型に形成し、隔壁3_{41}に副結合素子９を取り付けることによって副結合回路を極めて簡潔小型に形成した場合を例示したが、共振素子2_1ないし2_4を一列に配設しても本発明を実施することができる。図１には、４個の共振素子2_1ないし2_4を設けて回路次数が４の帯域通過ろ波器を構成した場合を例示すると共に、ループ９より成る１個の副結合回路を設けて１対の減衰極を有する有極形帯域通過ろ波器を構成した場合を例示してあるが、回路次数はこれを適宜増減して本発明を実施することができ、副結合回路も適宜複数個設けて複数対の減衰極を有する有極形帯域通過ろ波器を構成してもよい。但し、ループを用いて副結合回路を形成する場合には、２個又はその整数倍の個数の共振器を隔てた共振器相互を副結合し、容量素子を用いて副結合回路を形成する場合には、４個又はその整数倍の個数の共振器を隔てた共振器相互を副結合する必要があるので、所要の副結合回路の数に応じて回路次数を適宜増加する必要がある。又、副結合回路を設けることなく、無極形帯域通過ろ波器を構成する場合でも本発明を実施することができる。

【０００８】図２（ａ）は、本発明帯域通過ろ波器の電界分布を示す要部断面図［図２（ｂ）のＢ－Ｂ断面図、図２（ｂ）は、図２（ａ）のＡ－Ａ断面図、図２（ｃ）は、図２（ｂ）に相当する断面図で、図において矢印を付した実線は電界分布を、破線は磁界分布を、それぞれ示し、符号は図１と同様であるが、図２は図１に示した共振素子2_1ないし2_4を一列に並べ換えて隔壁3_{12} と3_{34} の間の部分のみを示したもので、段間結合係数調整素子5_{12} ないし5_{34} の各軸芯は、結合電界にほぼ平行で、結合磁界にほぼ直角である。図３は、本発明の他の実施例の要部を示す図で、図３（ａ）、図３（ｂ）及び図３（ｃ）の相互関係（断面関係）、図１との関係、電磁界分布、段間結合係数調整素子の軸芯と結合電界及び結合磁界との関係等は、図２と同様である。本実施例においては、隔壁3_{34} に設けた段間結合孔4_{34} を図示のように、隔壁3_{34} の上縁から下縁に亘る縦方向の比較的細長い孔隙で形成してある。図には示していないが、隔壁3_{12} 及び3_{23} に設ける段間結合孔も4_{34} と同様である。図４もまた本発明の他の実施例の要部を示す図で、図４（ａ）、図４（ｂ）及び図４（ｃ）の相互関係（断面関係）、図１との関係、電磁界分布、段間結合係数調整素子の軸芯と結合電界及び結合磁界との関係等は、図２と同様である。本実施例においては、隔壁3_{34} に設けた段間結合孔を図示のように、隔壁3_{34}の上縁及び両側縁の一部を輪郭線に含む横方向に細長い孔隙4_{341}、隔壁3_{34} の下縁及び両側縁の一部を輪郭線に含む横方向に細長い孔隙4_{343}、孔隙4_{341}と4_{343}の中間に両孔隙と平行に設けた横方向に細長い孔隙4_{342}で形成してある。図には示していないが、隔壁3_{12} 及び3_{23} に設ける段間結合孔も同様である。段間結合孔を図２ないし図４の何れの形状に形成した場合においても、段間結合係数調整素子5_{12} ないし5_{34} を前進又は後退させて、管内挿入長を変化させることによって、段間容量結合係数を変えることができる。即ち、段間結合係数調整素子5_{12} ないし5_{34} の各管内挿入長を長くすることによって、結合度が密になる方向に変化する。図２ないし図４に示した段間結合孔を有する本発明帯域通過ろ波器の各試作品について、本発明者が実測した結果、段間結合係数調整素子5_{12} ないし5_{34} の管内挿入長が最短の場合における段間結合係数に対して、管内挿入長が最大の場合における段間結合係数

をほぼ30%高められることを確かめることができた。尚、図２に示した段間結合孔は、負荷Ｑの高い共振器を形成する場合に好適で、図３に示した段間結合孔は、中程度の負荷Ｑの共振器を形成する場合に好適であり、図４に示した段間結合孔は、負荷Ｑの低い共振器を形成する場合に好適である。

【０００９】図５は、図１ないし図４について説明した本発明帯域通過ろ波器の等価回路図で、T_{80} は入力（又は出力）端子、M_{01} は入力（又は出力）磁気結合係数、M_{14}は副磁気結合係数、R_1ないしR_4は共振素子2_1ないし2_4と共通の外部導体１より成る共振回路、M_{41} は副磁気結合係数、C_{12} 、C_{23} 及びC_{34} は段間結合容量、M_{45}は出力（又は入力）磁気結合係数、T_{85} は出力（又は入力）端子である。

【００１０】図１ないし図５について説明した本発明帯域通過ろ波器の設計に当たっても、基準化低域通過ろ波器の素子値を求め、この値から回路定数を定めて所要の伝送特性を得ること従来の設計手法と同様で、以下、図６に回路図を、図７（横軸は基準化周波数、縦軸は減衰量、f_Cは基準化遮断周波数）に伝送特性の曲線図を、それぞれ示すようなチエビシエフ形基準化低域通過ろ波器の素子値g_1ないしg_nを基にして、通過域がチエビシエフ形特性で、減衰域がワグナ形特性を呈する帯域通過ろ波器を設計する場合について説明する。帯域通過ろ波器の設計上許容される通過域内における電圧定在波比（VSWR）をＳとすると、通過域内における許容リップルL_rは、次式で表わされる。

【数１】

$$L_r = 10\,\ell og\frac{(S+1)^2}{4S} \quad (\mathrm{dB}) \qquad \cdots\cdots (1)$$

上式から許容リップルL_rを求めると共に、回路次数ｎを定めて式（２）から素子値g_1を求め、式（３）から素子値g_2ないしg_nを求める。

【数２】

$$g_1 = \frac{2a_1}{\gamma} \qquad \cdots\cdots (2)$$

$$g_k = \frac{4a_{k-1}\cdot a_k}{b_{k-1}\cdot g_{k-1}} \qquad \cdots\cdots (3)$$

ｋ＝２、３、－－－－－、ｎ

【数３】

式（２）及び式（３）において、

$$\gamma = \sinh\frac{\beta}{2n} \qquad \cdots\cdots (4)$$

$$\beta = \ell_n\left(\coth\frac{Lr}{17.37}\right) \qquad \cdots\cdots (5)$$

$$a_k = \sin\frac{(2k-1)\pi}{2n} \qquad \cdots\cdots (6)$$

$$b_k = \gamma^2 + \sin^2\frac{k\pi}{n} \qquad \cdots\cdots (7)$$

尚、図６において、R_Lは負荷抵抗で、回路次数ｎが奇数の場合、

$$R_L = 1 \qquad \cdots\cdots (8)$$

【数４】

回路次数ｎが偶数の場合、

$$R_L = \coth^2\frac{\beta}{4} \qquad \cdots\cdots (9)$$

式（２）及び式（３）から求めた素子値g_1ないしg_n、帯域通過ろ波器の所要中心周波数f_0及び通過帯域幅B_{wr} から、入出力磁気結合係数M_{01}及びM_{45}は式（10）で、段間結合係数$K_{k,k+1}$ （ｋ＝１、２、３、－－－－－、ｎ－１）は式（11）で、それぞれ求めることができる。

【数５】

$$M_{01}=M_{45}\fallingdotseq\frac{2}{g_1}\left(\frac{Bwr}{f_0}\right)^{1/2} \quad \cdots\cdots (10)$$

$$K_{k,\,k+1}=\frac{2}{\sqrt{g_k\cdot g_{k+1}}}\cdot\frac{Bwr}{f_0} \quad \cdots\cdots (11)$$

入出力結合回路の設計製作は、従来の手法と同じであるが、本発明の要旨である段間結合部分については次のようにして形状寸法を定める。まず、回路次数n＝2で、共振素子間の隔壁に図2ないし図4について説明した段間結合孔（負荷Qの高低に応じて図2ないし図4に示した段間結合孔を選択する）を設けた帯域通過ろ波器を製作し、段間結合孔の寸法を適宜異ならせた際における段間結合係数を、段間結合係数測定器で測定すると共に、段間結合調整素子の管内挿入長を変えて各挿入長毎の段間結合係数を測定するか、最小及び最大管内挿入長における段間結合係数を測定し、式（11）の段間結合係数$K_{k,\,k+1}$の値を十分な余裕をもって満足する段間結合孔の寸法を選出し、回路次数nが所要の値を有する実際の帯域通過ろ波器の各隔壁に前記のようにして選出した寸法を有する段間結合孔を設け、各段間結合孔に設けた段間結合係数調整素子の管内挿入長を調整して、各段間の結合係数を所要値に一致させ、各共振回路毎に設けた共振周波数微調整素子の管内挿入長を調整して各共振回路の共振周波数を所要周波数に一致させる。尚、式（11）を用いることなく、段間結合孔の形状寸法、段間結合係数調整素子の長さ等を適当に定め、段間結合係数測定器で測定しながら、所謂カットアンドトライ方式によって段間結合孔の寸法、段間結合係数調整素子の長さ等を定める手法も用いることもできる。

【0011】図1ないし図5について説明した有極形の帯域通過ろ波器の通過域がチェビシェフ特性となるように構成した場合、その伝送特性は、次式で求めることができる。

【数6】

$$ATT=10\log\left\{1+\frac{(S-1)^2}{4S}Y_n^2(x)\right\}\ (\mathrm{dB}) \quad \cdots\cdots (12)$$

ATT ：伝送損失

図1に示したように、本発明帯域通過ろ波器の回路次数nが4、即ち、nが偶数の場合は、

【数7】

$$Y_n(x)=R_e\left\{\frac{\prod_1^{n/2}\left(\sqrt{1-x^2}+jm_i x\right)^2}{\prod_1^{n/2}\left(1-\frac{x^2}{\rho_i^2}\right)}\right\} \quad \cdots\cdots (13)$$

次数nが奇数の場合は、

【数8】

$$Y_n(x)=I_m\left\{\frac{\left(\sqrt{1-x^2}+jx\right)\prod_1^{\frac{n-1}{2}}\left(\sqrt{1-x^2}+jm_i x\right)^2}{\prod_1^{\frac{n-1}{2}}\left(1-\frac{x^2}{\rho_i^2}\right)}\right\}$$

$$\cdots\cdots (14)$$

$$\rho_i^2=\frac{1}{1-m_i^2} \quad \cdots\cdots (15)$$

$$\rho_i=\frac{f_0}{B_{wr}}\left(\frac{f_{\infty i}}{f_0}-\frac{f_0}{f_{\infty i}}\right) \quad \cdots\cdots (16)$$

$$m_i\fallingdotseq\left\{1-\left(\frac{f_{\infty 1}}{f_p}\right)\right\}^{1/2} \quad \cdots\cdots (17)$$

$f_{\infty i}$：減衰極を生ずる周波数

f_p：許容電圧定在波比を与えるバンドエッジの周波数上式においてR_eは実数部をとるの意、I_mは虚数部をとるの意である。図8は、図1ないし図5について説明した本発明有極形帯域通過ろ波器の実測に基づく伝送特性を示

す図で、横軸は周波数、縦軸は減衰量である。

【0012】図1ないし図5について説明した帯域通過ろ波器を無極形の帯域通過ろ波器に形成し、その通過域がチェビシェフ特性となるように構成した場合、その伝送特性は、次式で求めることができる。

【数9】

$$\mathrm{ATT} = 10\log\left\{1+\frac{(S-1)^2}{4S}T_n^2(x)\right\}\ (\mathrm{dB}) \quad \cdots\cdots (18)$$

ATT ：伝送損失

$T_n(x)$ ：チェビシェフの多項式で、

$x<1$ の場合、

$T_n(x) = \cos(n\ \cos^{-1} x)$

$x>1$ の場合、

$T_n(x) = \cosh(n\ \cosh^{-1} x)$

x：基準化周波数で、

【数10】

$$x=\frac{f_0}{B_{Wr}}\left(\frac{f}{f_0}-\frac{f_0}{f}\right) \quad \cdots\cdots (19)$$

f_0 ：帯域通過ろ波器の通過域における中心周波数

f：任意の伝送周波数

B_{Wr}：帯域通過ろ波器の許容通過周波数帯域幅

S：通過帯域内における許容電圧定在波比（VSWR）

【0013】図9は、図1ないし図5について説明した本発明有極形帯域通過ろ波器を用いて構成した分波器（したがってまた合波器）の一例を示す断面図［図1（a）に相当する断面図］で、1は共通の外部導体、2_1ないし2_8は共振素子で、図1に示したTE01δモード誘電体共振素子2_1ないし2_4と同様の共振素子である。3_{12}ないし3_{34}、3_{41}、3_{56}ないし3_{78}、3_{85}、3_{15}及び3_{48}は導体板より成る隔壁、4_{12}ないし4_{34}、4_{56}ないし4_{78}は段間結合孔で、図2ないし図4について説明した段間結合孔のうちの何れかの段間結合孔より成る。5_{12}ないし5_{34}、5_{56}ないし5_{78}は段間結合係数調整素子で、図1に示した段間結合係数調整素子5_{12}ないし5_{34}と同様の素子である。6_{12}ないし6_{34}、6_{56}ないし6_{78}はロックナット、7_{01}及び7_{02}は入力（又は出力）結合ループ、8_{01}及び8_{02}は入力（又は出力）端子、7_5及び7_9は出力（又は入力）結合ループ、8は共通の出力（又は入力）端子、9_1及び9_2は副結合用ループである。共振素子2_1ないし2_4の縦続接続回路及び共振素子2_5ないし2_8の縦続接続回路によって、それぞれ図1に示したものと同様の有極形帯域通過ろ波器が構成され、共振素子2_1ないし2_4の縦続接続回路によって構成される第1の有極形帯域通過ろ波器における通過域の中心周波数と、共振素子2_5ないし2_8の縦続接続回路によって構成される第2の有極形帯域通過ろ波器における通過域の中心周波数とを互いに適宜異ならせると共に、第1の有極形帯域通過ろ波器の出力（又は入力）結合ループ7_5の長さ、即ち、結合ループ7_5の接地端から共通の出力（又は入力）端子8を形成する同軸接栓における内部導体の延長部分への接続端までの長さを、電気長で、第2の有極形帯域通過ろ波器における通過域の中心周波数に対応する波長の$^1/_4$に形成し、第2の有極形帯域通過ろ波器の出力（又は入力）結合ループ7_9の長さ、即ち、結合ループ7_9の接地端から共通の出力（又は入力）端子8を形成する同軸接栓における内部導体の延長部分への接続端までの長さを、電気長で、第1の有極形帯域通過ろ波器における通過域の中心周波数に対応する波長の$^1/_4$に形成して、両帯域通過ろ波器の伝送信号相互の干渉を防ぐように構成してある。

【0014】図10は、図9に示した分波器の等価回路図で、T_{801}は入力（又は出力）端子、T_8は共通の出力（又は入力）端子、T_{802}は入力（又は出力）端子で、端子T_{801}から共通の端子T_8に到る回路、及び端子T_{802}から共通の端子T_8に到る回路は、それぞれ図5に示した回路と同様の構成で、各通過域における中心周波数が互いに異なる第1及び第2の有極形帯域通過ろ波器である。図9及び図10には、第1及び第2の有極形帯域通過ろ波器の各回路次数を4、各副結合回路数を1に選んであるが、これらの数はこれを任意適宜に選定して差し支えなく、又、第1及び第2の有極形帯域通過ろ波器を無極形に構成してもよい。図11は、図9及び図10に示した分波器の実測に基づく伝送特性を示す図で、横軸は周波数、縦軸は減衰量である。

【0015】

【発明の効果】本発明帯域通過ろ波器においては、段間結合係数調整素子の管内挿入長を変えることによって、段間結合係数を大幅に変化させることができる、即ち、本発明帯域通過ろ波器の試作品について実測した結果によれば、段間結合係数調整素子の管内挿入長を最小にした場合における段間結合係数に対して、段間結合係数調整素子の管内挿入長を最大にした場合における段間結合係数をほぼ30%高めることが可能であるから、隣り合う共振素子の中心間隔をすべて一定に保った場合でも、段間結合係数調整素子の管内挿入長を変えることによって任意所要の電気的特性を得ることができ、したがって、各種の電気的特性を有する帯域通過ろ波器の製作に当たって同一規格の部品を用いることができる。即ち、部品の標準化が可能となる。又、段間結合係数調整素子による調整操作を共通の外部導体の外側から行うことができるから、調整操作が比較的容易で、調整に要する時間も比較的短時間ですむから部品の標準化と相まってコスト

を低下させることができる。

【図面の簡単な説明】

【図１】本発明の一実施例を示す図である。

【図２】本発明の一実施例における電磁界分布を示す図である。

【図３】本発明の他の実施例における電磁界分布を示す図である。

【図４】本発明の他の実施例における電磁界分布を示す図である。

【図５】本発明帯域通過ろ波器の等価回路図である。

【図６】本発明帯域通過ろ波器の設計手法を説明するための図である。

【図７】本発明帯域通過ろ波器の設計手法を説明するための図である。

【図８】本発明帯域通過ろ波器の伝送特性を示す図である。

【図９】本発明帯域通過ろ波器より成る分波器を示す図である。

【図１０】本発明帯域通過ろ波器より成る分波器の等価回路図である。

【図１１】本発明帯域通過ろ波器より成る分波器の伝送特性を示す図である。

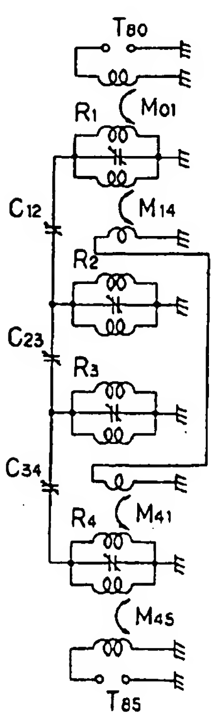
【図１２】従来の帯域通過ろ波器を示す図である。

【図１３】従来の帯域通過ろ波器を示す図である。

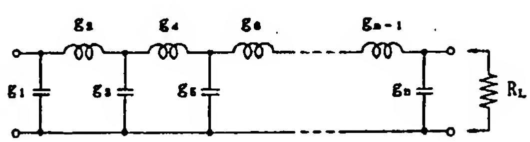
【符号の説明】

1	共通の外部導体
2_1〜2_8	共振素子
3_{12}〜3_{34}	隔壁
3_{41}	隔壁
3_{56}〜3_{78}	隔壁
3_{85}	隔壁
3_{15}	隔壁
3_{48}	隔壁
4_{12}〜4_{34}	段間結合孔
4_{341}〜4_{343}	段間結合孔
5_{12}〜5_{34}	段間結合係数調整素子
5_{56}〜5_{78}	段間結合係数調整素子
6_{12}〜6_{34}	ロックナット
6_{56}〜6_{78}	ロックナット
7_0	入力（又は出力）結合素子
7_5	出力（又は入力）結合素子
7_{01}、7_{02}	入力（又は出力）結合ループ
7_9	出力（又は入力）結合ループ
8_0、8_{01}、8_{02}	入力（又は出力）端子
8_5	出力（又は入力）端子
8	共通の出力（又は入力）端子
9	副結合素子
9_1、9_2	副結合用ループ
3_1〜3_3	隔壁
24_2	段間結合孔
34_1〜34_3	段間結合孔

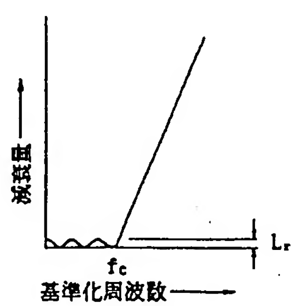
【図５】



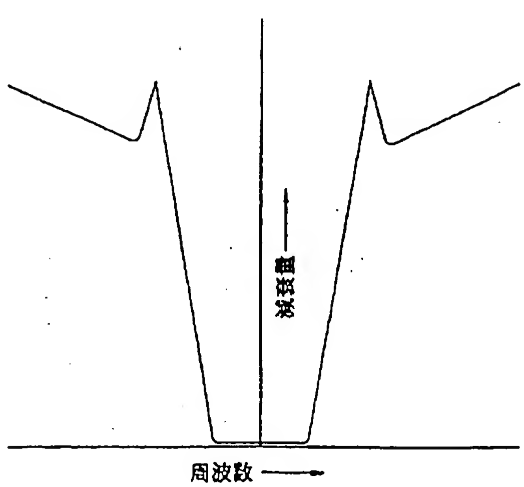
【図６】



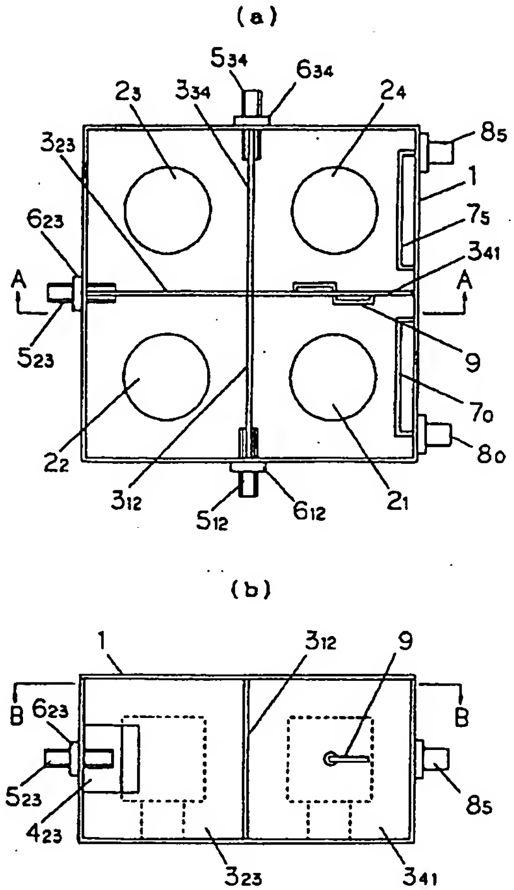
【図７】



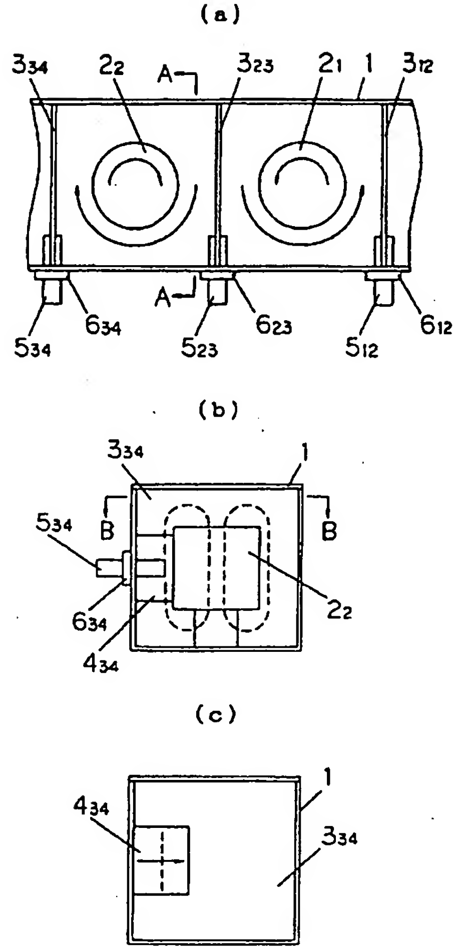
【図８】



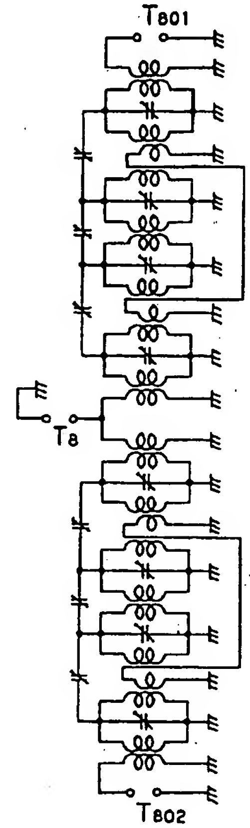
【図1】



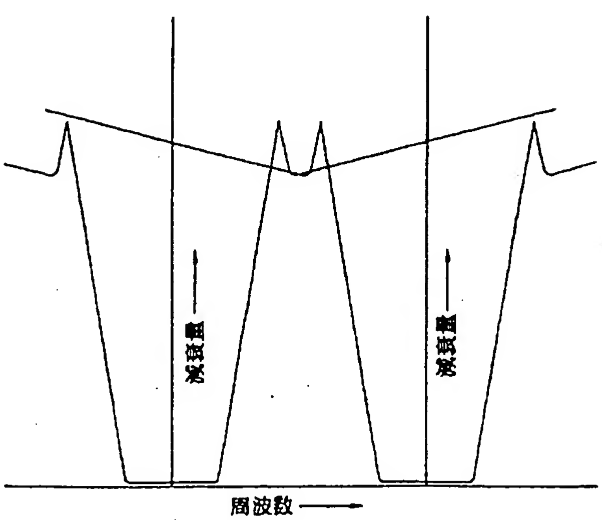
【図2】



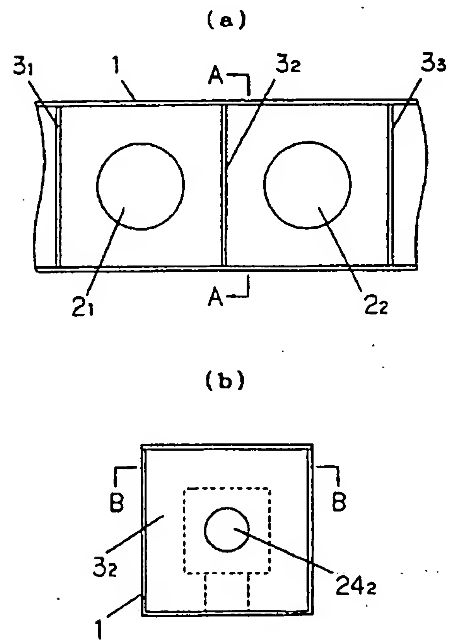
【図10】



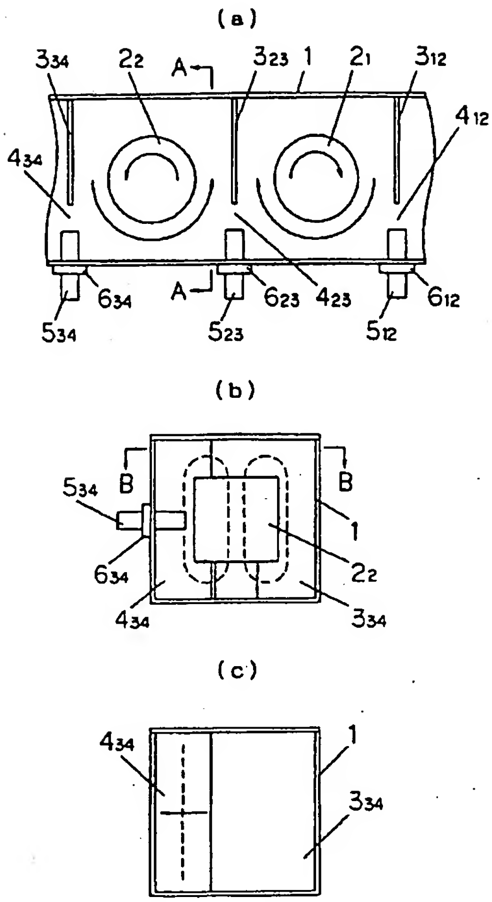
【図11】



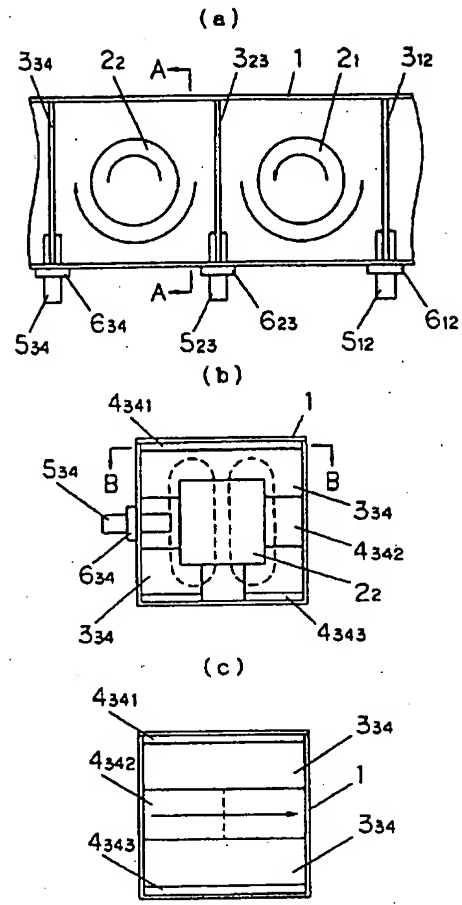
【図12】



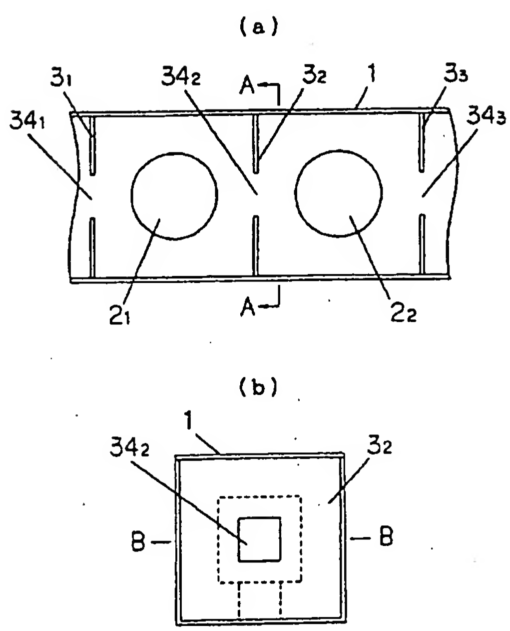
【図3】


(a)
3_{34} 2_2 A 3_{23} 1 2_1 3_{12}
4_{34} 4_{12}
A 6_{34} 6_{23} 4_{23} 6_{12}
5_{34} 5_{23} 5_{12}
(b)
5_{34} B B 1
6_{34} 2_2
4_{34} 3_{34}
(c)
4_{34} 1 3_{34}

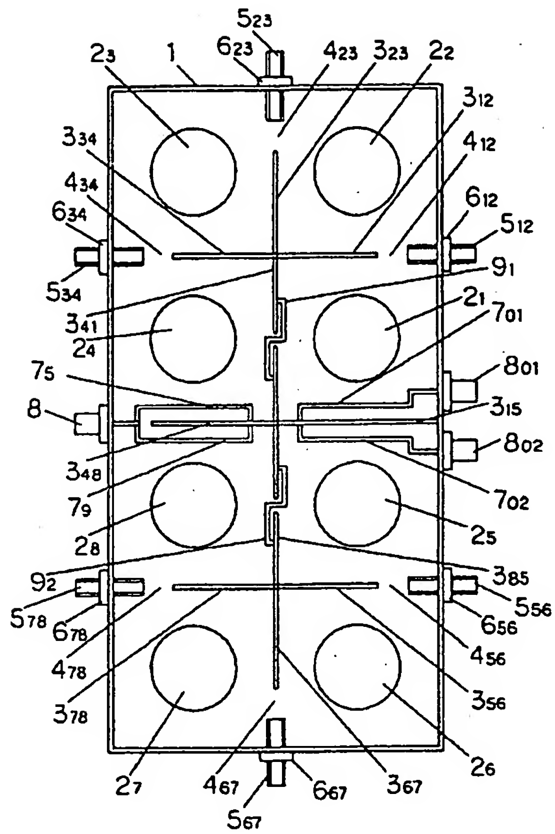
【図4】


(a)
3_{34} 2_2 A 3_{23} 1 2_1 3_{12}
A 5_{34} 6_{34} 5_{23} 6_{23} 5_{12} 6_{12}
(b)
4_{341} 1
5_{34} B B 3_{34}
6_{34} 4_{342} 2_2
3_{34} 4_{343}
(c)
4_{341} 3_{34}
4_{342} 1
4_{343} 3_{34}

【図13】


(a)
3_1 34_2 A 3_2 1 3_3
34_1 34_3
2_1 A 2_2
(b)
1
34_2 3_2
B B

【図9】


5_{23}
2_3
1
6_{23}
4_{23}
3_{23}
2_2
3_{12}
3_{34}
4_{12}
4_{34}
6_{34}
6_{12}
5_{12}
9_1
5_{34}
3_{41}
2_1
2_4
7_{01}
7_5
8_{01}
8
3_{15}
8_{02}
3_{48}
7_9
7_{02}
2_8
2_5
9_2
3_{85}
5_{78}
5_{56}
6_{78}
6_{56}
4_{78}
4_{56}
3_{78}
3_{56}
2_6
2_7
4_{67}
6_{67}
3_{67}
5_{67}

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to a band pass filter suitable as a constituent child of the splitter used for multiplexing or spectral separation of the band pass filter suitable as a band pass filter or RF signal used for removal of the noise included in a RF signal etc. in a radio communication equipment or broadcast equipment.
[0002]
[Description of the Prior Art] The cross section showing the important section of the conventional band pass filter with the high load Q which drawing 12 (a) makes **** connection of the resonator equipped with the TE01delta mode dielectric resonant element, and changes [the B-B cross section of drawing 12 (b)], Drawing 12 (b) is the A-A cross section of drawing 12 (a). An outer conductor with common 1, 21 and 22 -- a TE01delta mode dielectric resonant element, 31, or 33 -- a conductor -- the septum which consists of a board, and 242 The profile configuration dug to the core of a septum 32 is a circular interstage coupling hole, and has dug the same interstage coupling hole as other septa. The end view [the B-B end view of drawing 13 (b)] and drawing 13 (b) which show the important section of the conventional band pass filter with the high load Q of which drawing 13 (a) makes **** connection of the resonator equipped with the TE01delta mode dielectric resonant element, and consists are the A-A cross section of drawing 13 (a), and are 341. Or 343 A profile configuration is the interstage coupling hole of a square shape, and other signs are the same as that of drawing 12 .
[0003]
[Problem(s) to be Solved by the Invention] In the conventional band pass filter shown in drawing 12 or drawing 13 Circular interstage coupling hole 242 drilled in the septum 31 or the core of 33 Or interstage coupling hole 341 of a square shape Or although an interstage coupling coefficient is changed and the electrical property as a band pass filter is made in agreement with a necessary property by changing the size of 343 Interstage coupling hole 242 prepared in a septum 31 or 33 Or 341 Or 343 In order to make a size in agreement with the size corresponding to a necessary electrical property For example, since the septum which prepared many septa which dug the coupling hole of various kinds of sizes, repeated the septum considered to be suitable out of these septa, carried out selection wearing, and dug the interstage coupling hole of a necessary size is selected By the time it makes the size of an interstage coupling hole in agreement with a necessary value, many time and efforts cannot be needed, and it cannot escape becoming cost quantity.
[0004]
[Means for Solving the Problem] In between both the TE01delta mode dielectric resonant elements that adjoin each other among two or more TE01delta mode dielectric resonant elements by which **** connection is made into an outer conductor with a common this invention, and two or more aforementioned TE01delta mode dielectric resonant elements it prepares in the direction which puts an adjacent TE01delta mode dielectric resonant element in a row right-angled -- having -- a conductor -- with the septum which consists of a board The interstage coupling hole dug by the part which results in the direction of a center from the marginal part which touches the side attachment wall of an outer conductor

common to the above among the peripheries of the aforementioned septum, and an axis are almost parallel to the joint electric field in the drilling part of the aforementioned interstage coupling hole. While becoming almost right-angled at a joint magnetic field, an inner edge tends to remove the fault of the band pass filter which consists of the conventional dielectric resonator by realizing the band pass filter equipped with the interstage coupling-coefficient adjustment element prepared so that advance retreat might be carried out into the aforementioned interstage coupling hole.

[0005]

[Function] An interstage coupling coefficient changes sharply by changing the insertion length into the common outer conductor of an interstage coupling-coefficient adjustment element.

[0006]

[Example] The B-B cross section of cross section [drawing 1 (b) showing one example of this invention and drawing 1 (b) drawing 1 (a) With the A-A cross section of drawing 1 (a), an outer conductor with common 1, 21, or 24 is a TE01delta mode dielectric resonant element. [whether the supporting section which consists of the resonant-element main part which consists of the solid dielectric of the shape of a pillar with a comparatively large diameter, and the solid dielectric of the shape of a pillar with a comparatively small diameter is formed in one by the solid dielectric of the same quality of the material, and] It consists of the resonant element which formed the resonant-element main part by the solid dielectric with a comparatively high dielectric constant, formed supporting section separately by the low solid dielectric of a dielectric constant comparatively, respectively, and pasted up and formed both in one with adhesives. Although the case where a resonant element 21 or the profile configuration of the cross section of each main part of 24 is circular is illustrated in drawing, this invention can be carried out even if it uses the resonant element which formed the profile configuration of the cross section in the square shape. 312 323 and 334 And 341 respectively -- a conductor -- the septum which consists of a board, and 423 an interstage coupling hole -- it is -- septum 323 It has prepared in the part which results in the direction of a center from the marginal part which touches the side attachment wall of a common outer conductor among peripheries. although it has not appeared in drawing -- septum 312 And 334 Interstage coupling hole 423 The same interstage coupling hole is prepared. 512 523 And 534 It is an interstage coupling-coefficient adjustment element, respectively, and is the adjustment element 523 about the relation between each adjustment element, an interstage coupling hole, joint electric field, and a joint magnetic field. It is made an example and explains. Adjustment element 523 The axis is a septum 323. It is in agreement with a field and is the interstage coupling hole 423 from the side attachment wall of the common outer conductor 1. The insertion length (it is hereafter indicated as pipe interpolation close length) inside can be changed, and it consists of a fixable metal element, for example, the metal screw made to screw in the side attachment wall of the common outer conductor 1, in necessary pipe interpolation close length. drawing -- adjustment element 523 Interstage coupling hole 423 although the case of the height direction where it attaches in a core mostly is illustrated -- interstage coupling hole 423 You may attach in the part up and down shifted inside. Moreover, in drawing, it is the adjustment element 523. Although the axis has illustrated the case where it prepares so that it may intersect perpendicularly with the side attachment wall of the common outer conductor 1 Adjustment element 523 An axis is a septum 323. Dug interstage coupling hole 423 [in a field] You may prepare so that it may become slanting facing up or slanting facing down, namely, so that it may cross diagonally with the side attachment wall of the common outer conductor 1. in short Adjustment element 523 An axis is the interstage coupling hole 423. It is the adjustment element 523 so that it may be almost parallel to the joint electric field in a drilling part and may become almost right-angled at a joint magnetic field. this invention can be carried out by attaching. Other adjustment elements 512 And 534 Even if it attaches, it is the adjustment element 523. It is the same. Although 70 is an input (or output) joint element, 75 is an output (or input) joint element and the case where the joint elements 70 and 75 are formed in drawing by the loop is illustrated, you may form with capacity-coupling elements, such as a probe. 80 is an input (or output) terminal, 85 is an output (or input) terminal, and the case where it forms by the coaxial plug, respectively is illustrated. 9 is a subjoint element, and it may adopt conventionally the well-known circuitry which combines a subcoupled circuit with a main circuit through

the electrode which forms capacity between resonant elements instead of subcombining between the resonator which forms an element 9 by the loop and contains a resonant element 21 like illustration, and the resonators containing a resonant element 24. Although it has excluded illustrating the resonance frequency fine-tuning element of each resonator which consists of a resonant element 21 or 24 in drawing 1 The fine-tuning element used in the conventional TE01delta mode dielectric resonator in fact, and the same fine-tuning element, The longitudinal direction the rod-like structure which consists of a solid dielectric For example, a resonant element 21 or each 24 shaft orientations, That is, while it inserts into a resonator from the upper wall of the common outer conductor 1 as it becomes parallel to a direction perpendicular to space in drawing 1 (a), and being able to change each pipe interpolation close length minutely, the fine-tuning element formed so that it could fix in necessary pipe interpolation close length is prepared.
[0007] It is a septum 312, 323, and 334 to the interior of the outer conductor 1 common to drawing 1 . And 341 Arrange in a cross-shaped type and the interior of the common outer conductor 1 is divided into four rooms. Although the case where formed the whole small and a subcoupled circuit was formed small very briefly by attaching the subjoint element 9 in a septum 341 by arranging in the character type of KO the resonant element 21 attached in each loculus or 24 was illustrated this invention can be carried out even if it arranges a resonant element 21 or 24 in a single tier. Although the case where the owner pole type band pass filter which prepares one subcoupled circuit which consists of a loop 9, and has one pair of attenuation poles is constituted is illustrated to it while illustrating the case where prepared four resonant elements 21 or 24, and a circuit degree constitutes the band pass filter of 4, in drawing 1 A circuit degree may fluctuate this suitably, can carry out this invention, and may constitute the owner pole type band pass filter in which two or more subcoupled circuits are also suitably prepared, and have two or more pairs of attenuation poles. However, since it is necessary to subcombine both the resonators that separated the resonator of the number of four pieces or the integral multiple of those when subcombining both the resonators that separated the resonator of the number of two pieces or the integral multiple of those when a subcoupled circuit was formed using a loop and forming a subcoupled circuit using capacitative element, it is necessary to increase a circuit degree suitably according to the number of necessary subcoupled circuits. Moreover, this invention can be carried out even when it constitutes a nonpolar form band pass filter, without preparing a subcoupled circuit.
[0008] The B-B cross section of important section cross section [drawing 2 (b) showing the electric-field distribution of this invention band pass filter and drawing 2 (b) drawing 2 (a) Although the A-A cross section of drawing 2 (a) and drawing 2 (c) are the cross sections equivalent to drawing 2 (b), the solid line which attached the arrow in drawing shows an electric-field distribution, a dashed line shows a magnetic field distribution, respectively and the sign is the same as that of drawing 1 Drawing 2 rearranges into a single tier the resonant element 21 shown in drawing 1 , or 24, and is a septum 312. 334 It is what showed only the portion of a between and is the interstage coupling-coefficient adjustment element 512. Or 534 Each axis is almost parallel to joint electric field, and almost right-angled to a joint magnetic field. Drawing 3 is drawing showing the important section of other examples of this invention, and the relation between the axis of the interrelation (cross-section relation) of drawing 3 (a), drawing 3 (b), and drawing 3 (c), a relation with drawing 1 , an electromagnetic-field distribution, and an interstage coupling-coefficient adjustment element, joint electric field, and a joint magnetic field etc. is the same as that of drawing 2 . It sets to this example and is a septum 334. Prepared interstage coupling hole 434 Like illustration, it is a septum 334. It has formed by comparatively long and slender porous space lengthwise [ranging from the upper limb to the margo inferior]. although not shown in drawing -- septum 312 And 323 Also interstage coupling hole 434 to prepare It is the same. Drawing 4 is also drawing showing the important section of other examples of this invention, and the relation between the axis of the interrelation (cross-section relation) of drawing 4 (a), drawing 4 (b), and drawing 4 (c), a relation with drawing 1 , an electromagnetic-field distribution, and an interstage coupling-coefficient adjustment element, joint electric field, and a joint magnetic field etc. is the same as that of drawing 2 . It sets to this example and is a septum 334. The porous space 4341 long and slender in the longitudinal direction which contains some of upper limbs of a septum 334, and edges on both sides in a border line like illustration of the prepared interstage

coupling hole, and septum 334 It has formed in the middle of the porous space 4343 long and slender in the longitudinal direction which contains some of margo inferior and edges on both sides in a border line, and porous space 4341 and 4343 by both porous space and the porous space 4342 long and slender in the longitudinal direction prepared in parallel. although not shown in drawing -- septum 312 And 323 The same is said of the interstage coupling hole to prepare. It also sets, when an interstage coupling hole is formed in which configuration of drawing 2 or drawing 4 , and it is the interstage coupling-coefficient adjustment element 512. Or 534 An interstage capacity-coupling coefficient is changeable by making it move forward or retreat and changing pipe interpolation close length. Namely, interstage coupling-coefficient adjustment element 512 Or 534 By lengthening each pipe interpolation close length, degree of coupling changes in the direction which becomes dense. As a result of this invention person's surveying about each prototype of this invention band pass filter which has the interstage coupling hole shown in drawing 2 or drawing 4 , it is the interstage coupling-coefficient adjustment element 512. Or 534 It was able to confirm raising an interstage coupling coefficient in case pipe interpolation close length is the maximum about 30% to the interstage coupling coefficient in case pipe interpolation close length is the shortest. In addition, the interstage coupling hole shown in drawing 2 is suitable when forming a resonator with a high load Q, the interstage coupling hole shown in drawing 3 is suitable when forming the resonator of the load Q of a degree in the middle, and the interstage coupling hole shown in drawing 4 is suitable when forming the low resonator of a load Q.

[0009] Drawing 5 is the representative circuit schematic of this invention band pass filter explaining drawing 1 or drawing 4 . T80 An input (or output) terminal and M01 Input (or output) magnetic coupling coefficient, The resonance circuit to which a submagnetic coupling coefficient, R1, or R4 changes from the common outer conductor 1 with a resonant element 21 or 24 in M14, M41 A submagnetic coupling coefficient, C12, and C23 And C34 Interstage joint capacity and M45 are an output (or input) magnetic coupling coefficient and T85. It is an output (or input) terminal.

[0010] It is the same as that of the design technique of the acquiring [in the design of this invention band pass filter explaining drawing 1 or drawing 5 , calculate the element value of an scaling low pass filter, define a circuit constant from this value, and]-necessary transmission characteristic former. It carries out the element value g1 of a Chebyshev form scaling low pass filter as shows a circuit diagram hereafter to drawing 6 and shows the curvilinear view of a transmission characteristic to drawing 7 (the magnitude of attenuation and fC are [a horizontal axis] an scaling cut off frequency for scaling frequency and a vertical axis), respectively, or based on gn. A passage region explains the case where the band pass filter which a decay area presents a Wagner form property in a Chebyshev form property is designed. When the voltage standing wave ratio (VSWR) in the area within passage permitted on the design of a band pass filter is set to S, the permission ripple Lr in the area within passage is expressed with the following formula.

[Equation 1]

$$L_r = 10\,\ell og \frac{(S+1)^2}{4S} \quad \text{(dB)} \qquad \cdots\cdots (1)$$

While asking for the permission ripple Lr from an upper formula, the circuit degree n is defined, the element value g1 is calculated from a formula (2), and the element value g2 or gn is calculated from a formula (3).

[Equation 2]

$$g_1 = \frac{2a_1}{\gamma} \qquad \cdots\cdots (2)$$

$$g_k = \frac{4a_{k-1} \cdot a_k}{b_{k-1} \cdot g_{k-1}} \qquad \cdots\cdots (3)$$

k= -- 2, 3, -----, n formula (2), and a formula (3) -- setting -- [Equation 3]

$$\gamma = \sinh \frac{\beta}{2n} \quad \cdots\cdots (4)$$

$$\beta = \ell_n \left(\coth \frac{Lr}{17.37} \right) \quad \cdots\cdots (5)$$

$$a_k = \sin \frac{(2k-1)\pi}{2n} \quad \cdots\cdots (6)$$

$$b_k = \gamma^2 + \sin^2 \frac{k\pi}{n} \quad \cdots\cdots (7)$$

In addition, it is the case where RL is load resistance in drawing 6 , and the circuit degree n is odd. RL=1 .... (8) It is [Equation 4] when the circuit degree n is even.

$$R_L = \coth^2 \frac{\beta}{4} \quad \cdots\cdots (9)$$

the necessary center frequency fO and pass band width Bwr of the element value g1 calculated from the formula (2) and the formula (3) or gn, and a band pass filter from -- the I/O magnetic coupling coefficients M01 and M45 are formulas (10), and the interstage coupling coefficient Kk and k+1 (k= 1, 2 and 3, -----, n-1) are formulas (11), and they can calculate them, respectively

[Equation 5]

$$M_{01} = M_{45} \doteqdot \frac{2}{g_1} \left(\frac{Bwr}{f_0} \right)^{1/2} \quad \cdots\cdots (10)$$

$$K_{k,\,k+1} = \frac{2}{\sqrt{g_k \cdot g_{k+1}}} \cdot \frac{Bwr}{f_0} \quad \cdots\cdots (11)$$

Although design manufacture of an I/O coupled circuit is the same as the conventional technique, it defines a geometry as follows about a part for the interstage bond part which is the summary of this invention. First, the band pass filter which prepared the interstage coupling hole (the interstage coupling hole shown in drawing 2 or drawing 4 according to the height of a load Q is chosen) which explained drawing 2 or drawing 4 to the septum between resonant elements by the circuit degree n= 2 is manufactured. While measuring the interstage coupling coefficient at the time of changing the size of an interstage coupling hole suitably with an interstage coupling-coefficient measuring instrument [whether the pipe interpolation close length of an interstage joint adjustment element is changed, and the interstage coupling coefficient for every insertion length is measured, and] Measure the interstage coupling coefficient in the minimum and the maximum pipe interpolation close length, and the size of the interstage coupling hole which satisfies the interstage coupling coefficient Kk of a formula (11) and the value of k+1 with sufficient margin is elected. The pipe interpolation close length of an interstage coupling-coefficient adjustment element which prepared the interstage coupling hole which has the size which the circuit degree n is the above, and made and elected as each septum of the actual band pass filter which has a necessary value, and prepared in each interstage coupling hole is adjusted. The coupling coefficient of each interstage is made in agreement with a necessary value, the pipe interpolation close length of a resonance frequency fine-tuning element which prepared for every resonance circuit is adjusted, and the resonance frequency of each resonance circuit is made in agreement with necessary frequency. In addition, the technique of defining the size of an interstage coupling hole, the length of an interstage coupling-coefficient adjustment element, etc. with the so-called cut and a try method can also be used, defining suitably the geometry of an interstage coupling hole, the length of an interstage coupling-coefficient adjustment element, etc., and measuring with an interstage coupling-coefficient measuring instrument without using a formula (11).

[0011] When it constitutes so that the passage region of the band pass filter of owner pole type explaining drawing 1 or drawing 5 may serve as a Chebyshev characteristic, the transmission characteristic can be searched for by the following formula.

[Equation 6]

$$ATT = 10\log\left\{1+\frac{(S-1)^2}{4S}Y_n^2(x)\right\} \text{ (dB)} \quad \cdots\cdots (12)$$

ATT : it is [Equation 7], when the circuit degree n of this invention band pass filter is 4 and the number of n is even, as shown in transmission loss drawing 1 .

$$Y_n(x) = R_e\left\{\frac{\Pi_1^{n/2}(\sqrt{1-x^2}+jm_i x)^2}{\Pi_1^{n/2}\left(1-\frac{x^2}{\rho_i^2}\right)}\right\} \quad \cdots\cdots (13)$$

It is [Equation 8] when Degree n is odd.

$$Y_n(x) = I_m\left\{\frac{(\sqrt{1-x^2}+jx)\,\Pi_1^{\frac{n-1}{2}}(\sqrt{1-x^2}+jm_i x)^2}{\Pi_1^{\frac{n-1}{2}}\left(1-\frac{x^2}{\rho_i^2}\right)}\right\} \quad \cdots\cdots (14)$$

$$\rho_i^2 = \frac{1}{1-m_i^2} \quad \cdots\cdots (15)$$

$$\rho_i = \frac{f_0}{B_{Wr}}\left(\frac{f_{\infty i}}{f_0}-\frac{f_0}{f_{\infty i}}\right) \quad \cdots\cdots (16)$$

$$m_i \fallingdotseq \left\{1-\left(\frac{f_{\infty i}}{f_p}\right)\right\}^{1/2} \quad \cdots\cdots (17)$$

$f_{\infty i}$：減衰極を生ずる周波数

fp: Taking [Re]-in frequency top formula of band edge which gives allowable-voltage standing-wave ratio-real part mind, and Im are taking-imaginary part minds. Drawing 8 is drawing showing the transmission characteristic based on survey of this invention owner pole type band pass filter explaining drawing 1 or drawing 5 , a horizontal axis is frequency and a vertical axis is the magnitude of attenuation.
[0012] The band pass filter explaining drawing 1 or drawing 5 is formed in the band pass filter of a nonpolar form, and when it constitutes so that the passage region may serve as a Chebyshev characteristic, the transmission characteristic can be searched for by the following formula.
[Equation 9]

$$ATT = 10\log\left\{1+\frac{(S-1)^2}{4S}T_n^2(x)\right\} \text{ (dB)} \quad \cdots\cdots (18)$$

ATT : -- transmission loss Tn (x) : Chebyshev's polynomial -- x< 1 a case -- Tn (x) = cos (n cos-1x)
x> 1 a case -- Tn (x) =cosh (n cosh-1 x)
x: It is scaling frequency and is [Equation 10].

$$x = \frac{f_0}{B_{Wr}}\left(\frac{f}{f_0}-\frac{f_0}{f}\right) \quad \cdots\cdots (19)$$

f0 : center frequency f: in the passage region of a band pass filter -- arbitrary transmission-frequency BWr: -- allowable-voltage standing-wave ratio (VSWR) in the permission passage frequency bandwidth S:passband of a band pass filter [0013] Drawing 9 is the cross section [the cross section equivalent to drawing 1 (a)] showing an example of the splitter (therefore again multiplexing machine) constituted using this invention owner pole type band pass filter explaining drawing 1 or drawing 5 , and an outer conductor with common 1, 21, or 28 is a resonant element, and is the TE01delta mode dielectric resonant element 21 shown in drawing 1 , or the same resonant element as 24. 312 334, 341, and 356 Or 378, 385, and 315 And 348 a conductor -- the septum which consists of a board, and 412 Or 434 and 456 Or 478 It is an interstage coupling hole and consists of which interstage coupling hole of the interstage coupling holes explaining

drawing 2 or drawing 4 . [or] 512 Or 534 556 Or 578 Interstage coupling-coefficient adjustment element 512 which is an interstage coupling-coefficient adjustment element and was shown in drawing 1 Or 534 It is the same element. 612 Or 634 656 Or 678 A locknut and 701 And 702 An input (or output) coupling loop and 801 And 802 An input (or output) terminal, an output (or input) terminal with 75 and 79, and 91 and 92 are the loops for subcombination. [common / an output (or input) coupling loop and 8] By the resonant element 21 or the **** connection circuit of 24 and the resonant element 25, or the **** connection circuit of 28 The center frequency of the passage region in the 1st owner pole type band pass filter which the same owner pole type band pass filter as what was shown in drawing 1 , respectively is constituted, and is constituted by a resonant element 21 or the **** connection circuit of 24, While changing mutually suitably the center frequency of the passage region in the 2nd owner pole type band pass filter constituted by a resonant element 25 or the **** connection circuit of 28 The length of the output (or input) coupling loop 75 of the 1st owner pole type band pass filter, The length to the end connection from the grounding edge of a coupling loop 75 to the extension of the inner conductor in the coaxial plug which forms the common output (or input) terminal 8 namely, by electric length One fourth of the wavelength corresponding to the center frequency of the passage region in the 2nd owner pole type band pass filter It forms. The length of the output (or input) coupling loop 79 of the 2nd owner pole type band pass filter, The length to the end connection from the grounding edge of a coupling loop 79 to the extension of the inner conductor in the coaxial plug which forms the common output (or input) terminal 8 namely, by electric length One fourth of the wavelength corresponding to the center frequency of the passage region in the 1st owner pole type band pass filter It forms, and it constitutes so that the interference between transmission signals of both band pass filters may be prevented.
[0014] Drawing 10 is the representative circuit schematic of the splitter shown in drawing 9 , and an output (or input) terminal with T801 [common / an input (or output) terminal and T8] and T802 are input (or output) terminals. The circuit which results in the common terminal T8 from a terminal T801, and the circuit which results in the common terminal T8 from a terminal T802 are the same composition as the circuit shown in drawing 5 , respectively, and is the 1st and 2nd owner pole type band pass filters from which the center frequency in each passage region differs mutually. Although 4 and each number of ********** are chosen as drawing 9 and drawing 10 1 in each circuit degree of the 1st and 2nd owner pole type band pass filters, these numbers may select this arbitrarily suitably, and may not interfere, and may constitute the 1st and 2nd owner pole type band pass filters in a nonpolar form. Drawing 11 is drawing showing the transmission characteristic based on survey of the splitter shown in drawing 9 and drawing 10 , a horizontal axis is frequency and a vertical axis is the magnitude of attenuation.
[0015]
[Effect of the Invention] In this invention band pass filter, by changing the pipe interpolation close length of an interstage coupling-coefficient adjustment element According to the result which the interstage coupling coefficient could be changed sharply, namely, surveyed it about the prototype of this invention band pass filter As opposed to the interstage coupling coefficient at the time of making the pipe interpolation close length of an interstage coupling-coefficient adjustment element into the minimum Since it is possible to raise the interstage coupling coefficient at the time of making the pipe interpolation close length of an interstage coupling-coefficient adjustment element into the maximum about 30% Even when all the main intervals of an adjacent resonant element are kept constant, arbitrary necessary electrical properties can be acquired by changing the pipe interpolation close length of an interstage coupling-coefficient adjustment element. Therefore, the parts of the same specification can be used in manufacture of the band pass filter which has various kinds of electrical properties. That is, standardization of parts is attained. Moreover, since the time which adjustment operation is comparatively easy and adjustment takes since adjustment operation by the interstage coupling-coefficient adjustment element can be performed from the outside of a common outer conductor also ends comparatively for a short time, cost can be conjointly reduced with standardization of parts.

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EXAMPLE

[Example] The B-B cross section of cross section [drawing 1 (b) showing one example of this invention and drawing 1 (b) drawing 1 (a) With the A-A cross section of drawing 1 (a), an outer conductor with common 1, 21, or 24 is a TE01delta mode dielectric resonant element. [whether the supporting section which consists of the resonant-element main part which consists of the solid dielectric of the shape of a pillar with a comparatively large diameter, and the solid dielectric of the shape of a pillar with a comparatively small diameter is formed in one by the solid dielectric of the same quality of the material, and] It consists of the resonant element which formed the resonant-element main part by the solid dielectric with a comparatively high dielectric constant, formed supporting section separately by the low solid dielectric of a dielectric constant comparatively, respectively, and pasted up and formed both in one with adhesives. Although the case where a resonant element 21 or the profile configuration of the cross section of each main part of 24 is circular is illustrated in drawing, this invention can be carried out even if it uses the resonant element which formed the profile configuration of the cross section in the square shape. 312 323 and 334 And 341 respectively -- a conductor -- the septum which consists of a board, and 423 an interstage coupling hole -- it is -- septum 323 It has prepared in the part which results in the direction of a center from the marginal part which touches the side attachment wall of a common outer conductor among peripheries. although it has not appeared in drawing -- septum 312 And 334 Interstage coupling hole 423 The same interstage coupling hole is prepared. 512 523 And 534 It is an interstage coupling-coefficient adjustment element, respectively, and is the adjustment element 523 about the relation between each adjustment element, an interstage coupling hole, joint electric field, and a joint magnetic field. It is made an example and explains. Adjustment element 523 The axis is a septum 323. It is in agreement with a field and is the interstage coupling hole 423 from the side attachment wall of the common outer conductor 1. The insertion length (it is hereafter indicated as pipe interpolation close length) inside can be changed, and it consists of a fixable metal element, for example, the metal screw made to screw in the side attachment wall of the common outer conductor 1, in necessary pipe interpolation close length. drawing -- adjustment element 523 Interstage coupling hole 423 although the case of the height direction where it attaches in a core mostly is illustrated -- interstage coupling hole 423 You may attach in the part up and down shifted inside. Moreover, in drawing, it is the adjustment element 523. Although the axis has illustrated the case where it prepares so that it may intersect perpendicularly with the side attachment wall of the common outer conductor 1 Adjustment element 523 An axis is a septum 323. Dug interstage coupling hole 423 [in a field] You may prepare so that it may become slanting facing up or slanting facing down, namely, so that it may cross diagonally with the side attachment wall of the common outer conductor 1. in short Adjustment element 523 An axis is the interstage coupling hole 423. It is the adjustment element 523 so that it may be almost parallel to the joint electric field in a drilling part and may become almost right-angled at a joint magnetic field. this invention can be carried out by attaching. Other adjustment elements 512 And 534 Even if it attaches, it is the adjustment element 523. It is the same. Although 70 is an input (or output) joint element, 75 is an output (or input) joint element and the case where the joint elements 70 and 75 are formed in drawing by the loop is illustrated, you may form with capacity-coupling elements, such as a probe. 80 is an input (or output) terminal, 85 is an output (or input) terminal, and the case where it forms by the coaxial plug, respectively is illustrated. 9 is a subjoint element, and it may adopt

conventionally the well-known circuitry which combines a subcoupled circuit with a main circuit through the electrode which forms capacity between resonant elements instead of subcombining between the resonator which forms an element 9 by the loop and contains a resonant element 21 like illustration, and the resonators containing a resonant element 24. Although it has excluded illustrating the resonance frequency fine-tuning element of each resonator which consists of a resonant element 21 or 24 in drawing 1 The fine-tuning element used in the conventional TE01delta mode dielectric resonator in fact, and the same fine-tuning element, The longitudinal direction the rod-like structure which consists of a solid dielectric For example, a resonant element 21 or each 24 shaft orientations, That is, while it inserts into a resonator from the upper wall of the common outer conductor 1 as it becomes parallel to a direction perpendicular to space in drawing 1 (a), and being able to change each pipe interpolation close length minutely, the fine-tuning element formed so that it could fix in necessary pipe interpolation close length is prepared.
[0007] It is a septum 312, 323, and 334 to the interior of the outer conductor 1 common to drawing 1 . And 341 Arrange in a cross-shaped type and the interior of the common outer conductor 1 is divided into four rooms. Although the case where formed the whole small and a subcoupled circuit was formed small very briefly by attaching the subjoint element 9 in a septum 341 by arranging in the character type of KO the resonant element 21 attached in each loculus or 24 was illustrated this invention can be carried out even if it arranges a resonant element 21 or 24 in a single tier. Although the case where the owner pole type band pass filter which prepares one subcoupled circuit which consists of a loop 9, and has one pair of attenuation poles is constituted is illustrated to it while illustrating the case where prepared four resonant elements 21 or 24, and a circuit degree constitutes the band pass filter of 4, in drawing 1 A circuit degree may fluctuate this suitably, can carry out this invention, and may constitute the owner pole type band pass filter in which two or more subcoupled circuits are also suitably prepared, and have two or more pairs of attenuation poles. However, since it is necessary to subcombine both the resonators that separated the resonator of the number of four pieces or the integral multiple of those when subcombining both the resonators that separated the resonator of the number of two pieces or the integral multiple of those when a subcoupled circuit was formed using a loop and forming a subcoupled circuit using capacitative element, it is necessary to increase a circuit degree suitably according to the number of necessary subcoupled circuits. Moreover, this invention can be carried out even when it constitutes a nonpolar form band pass filter, without preparing a subcoupled circuit.
[0008] The B-B cross section of important section cross section [drawing 2 (b) showing the electric-field distribution of this invention band pass filter and drawing 2 (b) drawing 2 (a) Although the A-A cross section of drawing 2 (a) and drawing 2 (c) are the cross sections equivalent to drawing 2 (b), the solid line which attached the arrow in drawing shows an electric-field distribution, a dashed line shows a magnetic field distribution, respectively and the sign is the same as that of drawing 1 Drawing 2 rearranges into a single tier the resonant element 21 shown in drawing 1 , or 24, and is a septum 312. 334 It is what showed only the portion of a between and is the interstage coupling-coefficient adjustment element 512. Or 534 Each axis is almost parallel to joint electric field, and almost right-angled to a joint magnetic field. Drawing 3 is drawing showing the important section of other examples of this invention, and the relation between the axis of the interrelation (cross-section relation) of drawing 3 (a), drawing 3 (b), and drawing 3 (c), a relation with drawing 1 , an electromagnetic-field distribution, and an interstage coupling-coefficient adjustment element, joint electric field, and a joint magnetic field etc. is the same as that of drawing 2 . It sets to this example and is a septum 334. Prepared interstage coupling hole 434 Like illustration, it is a septum 334. It has formed by comparatively long and slender porous space lengthwise [ranging from the upper limb to the margo inferior]. although not shown in drawing -- septum 312 And 323 Also interstage coupling hole 434 to prepare It is the same. Drawing 4 is also drawing showing the important section of other examples of this invention, and the relation between the axis of the interrelation (cross-section relation) of drawing 4 (a), drawing 4 (b), and drawing 4 (c), a relation with drawing 1 , an electromagnetic-field distribution, and an interstage coupling-coefficient adjustment element, joint electric field, and a joint magnetic field etc. is the same as that of drawing 2 . It sets to this example and is a septum 334. The porous space 4341 long and slender in the longitudinal direction which contains some of upper

limbs of a septum 334, and edges on both sides in a border line like illustration of the prepared interstage coupling hole, and septum 334 It has formed in the middle of the porous space 4343 long and slender in the longitudinal direction which contains some of margo inferior and edges on both sides in a border line, and porous space 4341 and 4343 by both porous space and the porous space 4342 long and slender in the longitudinal direction prepared in parallel. although not shown in drawing -- septum 312 And 323 The same is said of the interstage coupling hole to prepare. It also sets, when an interstage coupling hole is formed in which configuration of drawing 2 or drawing 4 , and it is the interstage coupling-coefficient adjustment element 512. Or 534 An interstage capacity-coupling coefficient is changeable by making it move forward or retreat and changing pipe interpolation close length. Namely, interstage coupling-coefficient adjustment element 512 Or 534 By lengthening each pipe interpolation close length, degree of coupling changes in the direction which becomes dense. As a result of this invention person's surveying about each prototype of this invention band pass filter which has the interstage coupling hole shown in drawing 2 or drawing 4 , it is the interstage coupling-coefficient adjustment element 512. Or 534 It was able to confirm raising an interstage coupling coefficient in case pipe interpolation close length is the maximum about 30% to the interstage coupling coefficient in case pipe interpolation close length is the shortest. In addition, the interstage coupling hole shown in drawing 2 is suitable when forming a resonator with a high load Q, the interstage coupling hole shown in drawing 3 is suitable when forming the resonator of the load Q of a degree in the middle, and the interstage coupling hole shown in drawing 4 is suitable when forming the low resonator of a load Q.

[0009] Drawing 5 is the representative circuit schematic of this invention band pass filter explaining drawing 1 or drawing 4 . T80 An input (or output) terminal and M01 Input (or output) magnetic coupling coefficient, The resonance circuit to which a submagnetic coupling coefficient, R1, or R4 changes from the common outer conductor 1 with a resonant element 21 or 24 in M14, M41 A submagnetic coupling coefficient, C12, and C23 And C34 Interstage joint capacity and M45 are an output (or input) magnetic coupling coefficient and T85. It is an output (or input) terminal.

[0010] It is the same as that of the design technique of the acquiring [in the design of this invention band pass filter explaining drawing 1 or drawing 5 , calculate the element value of an scaling low pass filter, define a circuit constant from this value, and]-necessary transmission characteristic former. It carries out the element value g1 of a Chebyshev form scaling low pass filter as shows a circuit diagram hereafter to drawing 6 and shows the curvilinear view of a transmission characteristic to drawing 7 (the magnitude of attenuation and fC are [a horizontal axis] an scaling cut off frequency for scaling frequency and a vertical axis), respectively, or based on gn. A passage region explains the case where the band pass filter which a decay area presents a Wagner form property in a Chebyshev form property is designed. When the voltage standing wave ratio (VSWR) in the area within passage permitted on the design of a band pass filter is set to S, the permission ripple Lr in the area within passage is expressed with the following formula.

[Equation 1]

$$L_r = 10 \log \frac{(S+1)^2}{4S} \quad (\mathrm{dB}) \qquad \cdots\cdots (1)$$

While asking for the permission ripple Lr from an upper formula, the circuit degree n is defined, the element value g1 is calculated from a formula (2), and the element value g2 or gn is calculated from a formula (3).

[Equation 2]

$$g_1 = \frac{2a_1}{\gamma} \qquad \cdots\cdots (2)$$

$$g_k = \frac{4a_{k-1} \cdot a_k}{b_{k-1} \cdot g_{k-1}} \qquad \cdots\cdots (3)$$

k= -- 2, 3, -----, n formula (2), and a formula (3) -- setting -- [Equation 3]

$$\gamma = \sinh \frac{\beta}{2n} \quad \cdots\cdots (4)$$

$$\beta = \ell_n \left(\coth \frac{Lr}{17.37} \right) \quad \cdots\cdots (5)$$

$$a_k = \sin \frac{(2k-1)\pi}{2n} \quad \cdots\cdots (6)$$

$$b_k = \gamma^2 + \sin^2 \frac{k\pi}{n} \quad \cdots\cdots (7)$$

In addition, it is the case where RL is load resistance in drawing 6 , and the circuit degree n is odd. RL=1 .... (8) It is [Equation 4] when the circuit degree n is even.

$$R_L = \coth^2 \frac{\beta}{4} \quad \cdots\cdots (9)$$

the necessary center frequency fO and pass band width Bwr of the element value g1 calculated from the formula (2) and the formula (3) or gn, and a band pass filter from -- the I/O magnetic coupling coefficients M01 and M45 are formulas (10), and the interstage coupling coefficient Kk and k+1 (k= 1, 2 and 3, -----, n-1) are formulas (11), and they can calculate them, respectively

[Equation 5]

$$M_{01} = M_{45} \doteqdot \frac{2}{g_1} \left(\frac{Bwr}{f_0} \right)^{1/2} \quad \cdots\cdots (10)$$

$$K_{k,k+1} = \frac{2}{\sqrt{g_k \cdot g_{k+1}}} \cdot \frac{Bwr}{f_0} \quad \cdots\cdots (11)$$

Although design manufacture of an I/O coupled circuit is the same as the conventional technique, it defines a geometry as follows about a part for the interstage bond part which is the summary of this invention. First, the band pass filter which prepared the interstage coupling hole (the interstage coupling hole shown in drawing 2 or drawing 4 according to the height of a load Q is chosen) which explained drawing 2 or drawing 4 to the septum between resonant elements by the circuit degree n= 2 is manufactured. While measuring the interstage coupling coefficient at the time of changing the size of an interstage coupling hole suitably with an interstage coupling-coefficient measuring instrument [whether the pipe interpolation close length of an interstage joint adjustment element is changed, and the interstage coupling coefficient for every insertion length is measured, and] Measure the interstage coupling coefficient in the minimum and the maximum pipe interpolation close length, and the size of the interstage coupling hole which satisfies the interstage coupling coefficient Kk of a formula (11) and the value of k+1 with sufficient margin is elected. The pipe interpolation close length of an interstage coupling-coefficient adjustment element which prepared the interstage coupling hole which has the size which the circuit degree n is the above, and made and elected as each septum of the actual band pass filter which has a necessary value, and prepared in each interstage coupling hole is adjusted. The coupling coefficient of each interstage is made in agreement with a necessary value, the pipe interpolation close length of a resonance frequency fine-tuning element which prepared for every resonance circuit is adjusted, and the resonance frequency of each resonance circuit is made in agreement with necessary frequency. In addition, the technique of defining the size of an interstage coupling hole, the length of an interstage coupling-coefficient adjustment element, etc. with the so-called cut and a try method can also be used, defining suitably the geometry of an interstage coupling hole, the length of an interstage coupling-coefficient adjustment element, etc., and measuring with an interstage coupling-coefficient measuring instrument without using a formula (11).

[0011] When it constitutes so that the passage region of the band pass filter of owner pole type explaining drawing 1 or drawing 5 may serve as a Chebyshev characteristic, the transmission characteristic can be searched for by the following formula.

[Equation 6]

$$ATT = 10\log\left\{1 + \frac{(S-1)^2}{4S} Y_n^2(x)\right\} \text{ (dB)} \quad \cdots\cdots (12)$$

ATT : it is [Equation 7], when the circuit degree n of this invention band pass filter is 4 and the number of n is even, as shown in transmission loss drawing 1 .

$$Y_n(x) = R_e\left\{\frac{\Pi_i^{n/2}(\sqrt{1-x^2} + j m_i x)^2}{\Pi_i^{n/2}\left(1 - \frac{x^2}{\rho_i^2}\right)}\right\} \quad \cdots\cdots (13)$$

It is [Equation 8] when Degree n is odd.

$$Y_n(x) = I_m\left\{\frac{(\sqrt{1-x^2} + j x)\,\Pi_i^{\frac{n-1}{2}}(\sqrt{1-x^2} + j m_i x)^2}{\Pi_i^{\frac{n-1}{2}}\left(1 - \frac{x^2}{\rho_i^2}\right)}\right\}$$

$$\cdots\cdots (14)$$

$$\rho_i^2 = \frac{1}{1-m_i^2} \quad \cdots\cdots (15)$$

$$\rho_i = \frac{f_0}{B_{wr}}\left(\frac{f_{\infty i}}{f_0} - \frac{f_0}{f_{\infty i}}\right) \quad \cdots\cdots (16)$$

$$m_i \fallingdotseq \left\{1 - \left(\frac{f_{\infty i}}{f_p}\right)\right\}^{1/2} \quad \cdots\cdots (17)$$

$f_{\infty i}$：減衰極を生ずる周波数

fp: Taking [Re]-in frequency top formula of band edge which gives allowable-voltage standing-wave ratio-real part mind, and Im are taking-imaginary part minds. Drawing 8 is drawing showing the transmission characteristic based on survey of this invention owner pole type band pass filter explaining drawing 1 or drawing 5 , a horizontal axis is frequency and a vertical axis is the magnitude of attenuation. [0012] The band pass filter explaining drawing 1 or drawing 5 is formed in the band pass filter of a nonpolar form, and when it constitutes so that the passage region may serve as a Chebyshev characteristic, the transmission characteristic can be searched for by the following formula.
[Equation 9]

$$ATT = 10\log\left\{1 + \frac{(S-1)^2}{4S} T_n^2(x)\right\} \text{ (dB)} \quad \cdots\cdots (18)$$

ATT : -- transmission loss Tn (x) : Chebyshev's polynomial -- x< 1 a case -- Tn (x) = cos (n cos-1x)
x> 1 a case -- Tn (x) =cosh (n cosh-1 x)
x: It is scaling frequency and is [Equation 10].

$$x = \frac{f_0}{B_{wr}}\left(\frac{f}{f_0} - \frac{f_0}{f}\right) \quad \cdots\cdots (19)$$

f0 : center frequency f: in the passage region of a band pass filter -- arbitrary transmission-frequency BWr: -- allowable-voltage standing-wave ratio (VSWR) in the permission passage frequency bandwidth S:passband of a band pass filter [0013] Drawing 9 is the cross section [the cross section equivalent to drawing 1 (a)] showing an example of the splitter (therefore again multiplexing machine) constituted using this invention owner pole type band pass filter explaining drawing 1 or drawing 5 , and an outer conductor with common 1, 21, or 28 is a resonant element, and is the TE01delta mode dielectric resonant element 21 shown in drawing 1 , or the same resonant element as 24. 312 334, 341, and 356 Or 378, 385, and 315 And 348 a conductor -- the septum which consists of a board, and 412 Or 434 and 456 Or 478 It is an interstage coupling hole and consists of which interstage coupling hole of the interstage coupling holes explaining

drawing 2 or drawing 4 . [or] 512 Or 534 556 Or 578 Interstage coupling-coefficient adjustment element 512 which is an interstage coupling-coefficient adjustment element and was shown in drawing 1 Or 534 It is the same element. 612 Or 634 656 Or 678 A locknut and 701 And 702 An input (or output) coupling loop and 801 And 802 An input (or output) terminal, an output (or input) terminal with 75 and 79, and 91 and 92 are the loops for subcombination. [common / an output (or input) coupling loop and 8] By the resonant element 21 or the **** connection circuit of 24 and the resonant element 25, or the **** connection circuit of 28 The center frequency of the passage region in the 1st owner pole type band pass filter which the same owner pole type band pass filter as what was shown in drawing 1 , respectively is constituted, and is constituted by a resonant element 21 or the **** connection circuit of 24, While changing mutually suitably the center frequency of the passage region in the 2nd owner pole type band pass filter constituted by a resonant element 25 or the **** connection circuit of 28 The length of the output (or input) coupling loop 75 of the 1st owner pole type band pass filter, The length to the end connection from the grounding edge of a coupling loop 75 to the extension of the inner conductor in the coaxial plug which forms the common output (or input) terminal 8 namely, by electric length One fourth of the wavelength corresponding to the center frequency of the passage region in the 2nd owner pole type band pass filter It forms. The length of the output (or input) coupling loop 79 of the 2nd owner pole type band pass filter, The length to the end connection from the grounding edge of a coupling loop 79 to the extension of the inner conductor in the coaxial plug which forms the common output (or input) terminal 8 namely, by electric length One fourth of the wavelength corresponding to the center frequency of the passage region in the 1st owner pole type band pass filter It forms, and it constitutes so that the interference between transmission signals of both band pass filters may be prevented.

[0014] Drawing 10 is the representative circuit schematic of the splitter shown in drawing 9 , and an output (or input) terminal with T801 [common / an input (or output) terminal and T8] and T802 are input (or output) terminals. The circuit which results in the common terminal T8 from a terminal T801, and the circuit which results in the common terminal T8 from a terminal T802 are the same composition as the circuit shown in drawing 5 , respectively, and is the 1st and 2nd owner pole type band pass filters from which the center frequency in each passage region differs mutually. Although 4 and each number of ********** are chosen as drawing 9 and drawing 10 1 in each circuit degree of the 1st and 2nd owner pole type band pass filters, these numbers may select this arbitrarily suitably, and may not interfere, and may constitute the 1st and 2nd owner pole type band pass filters in a nonpolar form. Drawing 11 is drawing showing the transmission characteristic based on survey of the splitter shown in drawing 9 and drawing 10 , a horizontal axis is frequency and a vertical axis is the magnitude of attenuation.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] The cross section showing the important section of the conventional band pass filter with the high load Q which drawing 12 (a) makes **** connection of the resonator equipped with the TE01delta mode dielectric resonant element, and changes [the B-B cross section of drawing 12 (b)], Drawing 12 (b) is the A-A cross section of drawing 12 (a). An outer conductor with common 1, 21 and 22 -- a TE01delta mode dielectric resonant element, 31, or 33 -- a conductor -- the septum which consists of a board, and 242 The profile configuration dug to the core of a septum 32 is a circular interstage coupling hole, and has dug the same interstage coupling hole as other septa. The end view [the B-B end view of drawing 13 (b)] and drawing 13 (b) which show the important section of the conventional band pass filter with the high load Q of which drawing 13 (a) makes **** connection of the resonator equipped with the TE01delta mode dielectric resonant element, and consists are the A-A cross section of drawing 13 (a), and are 341. Or 343 A profile configuration is the interstage coupling hole of a square shape, and other signs are the same as that of drawing 12 .

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the conventional band pass filter shown in drawing 12 or drawing 13 Circular interstage coupling hole 242 drilled in the septum 31 or the core of 33 Or interstage coupling hole 341 of a square shape Or although an interstage coupling coefficient is changed and the electrical property as a band pass filter is made in agreement with a necessary property by changing the size of 343 Interstage coupling hole 242 prepared in a septum 31 or 33 Or 341 Or 343 In order to make a size in agreement with the size corresponding to a necessary electrical property For example, since the septum which prepared many septa which dug the coupling hole of various kinds of sizes, repeated the septum considered to be suitable out of these septa, carried out selection wearing, and dug the interstage coupling hole of a necessary size is selected By the time it makes the size of an interstage coupling hole in agreement with a necessary value, many time and efforts cannot be needed, and it cannot escape becoming cost quantity.

[Translation done.]

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MEANS

[Means for Solving the Problem] this invention is by realizing a band pass filter between both the TE01delta mode dielectric resonant elements that adjoin each other among two or more TE01delta mode dielectric resonant elements which are characterized by providing the following in what is going to remove the fault of the band pass filter which consists of the conventional dielectric resonator, and by which **** connection is made into a common outer conductor, and two or more aforementioned TE01delta mode dielectric resonant elements. it prepares in the direction which puts an adjacent TE01delta mode dielectric resonant element in a row right-angled -- having -- a conductor -- the septum which consists of a board The interstage coupling hole dug by the part which results in the direction of a center from the edge which touches the side attachment wall of an outer conductor common to the above among the peripheries of the aforementioned septum. The interstage coupling-coefficient adjustment element prepared so that [an inner edge] it might be made to carry out advance retreat in the aforementioned interstage coupling hole while the axis was almost parallel to the joint electric field in the drilling part of the aforementioned interstage coupling hole and became almost right-angled at the joint magnetic field.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing one example of this invention.
[Drawing 2] It is drawing showing the electromagnetic-field distribution in one example of this invention.
[Drawing 3] It is drawing showing the electromagnetic-field distribution in other examples of this invention.
[Drawing 4] It is drawing showing the electromagnetic-field distribution in other examples of this invention.
[Drawing 5] It is the representative circuit schematic of this invention band pass filter.
[Drawing 6] It is drawing for explaining the design technique of this invention band pass filter.
[Drawing 7] It is drawing for explaining the design technique of this invention band pass filter.
[Drawing 8] It is drawing showing the transmission characteristic of this invention band pass filter.
[Drawing 9] It is drawing showing the splitter which consists of this invention band pass filter.
[Drawing 10] It is the representative circuit schematic of the splitter which consists of this invention band pass filter.
[Drawing 11] It is drawing showing the transmission characteristic of the splitter which consists of this invention band pass filter.
[Drawing 12] It is drawing showing the conventional band pass filter.
[Drawing 13] It is drawing showing the conventional band pass filter.
[Description of Notations]
1 Common Outer Conductor
21-28 Resonant element
312 -334 Septum
341 Septum
356 -378 Septum
385 Septum
315 Septum
348 Septum
412 -434 Interstage Coupling Hole
4341-4343 Interstage coupling hole
512 -534 Interstage Coupling-Coefficient Adjustment Element
556 -578 Interstage Coupling-Coefficient Adjustment Element
612 -634 Locknut
656 -678 Locknut
70 Input (or Output) Joint Element
75 Output (or Input) Joint Element
701 702 Input (or Output) Coupling Loop
79 Output (or Input) Coupling Loop
80,801 802 Input (or output) terminal
85 Output (or Input) Terminal

8 Common Output (or Input) Terminal
9 SubJoint Element
91 92 Loop for subcombination
31-33 Septum
242 Interstage Coupling Hole
341 -343 Interstage Coupling Hole

[Translation done.]